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The Ecology of Design

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A satellite image of contemporary night-time Europe affords a revealing glance into the history of Western civilization. Superimposing maps of Roman roads from 117 CE, the zenith of the great empire's geographical extension, onto satellite images of European nightlight density, **Dalgaard and colleagues' research** came to a compelling conclusion: Roman road density is a surprisingly good causal predictor for contemporary road density and economic activity.¹ In other words, the persistence of roads and road infrastructure over a remarkable two millennia has paved the way for modern European road networks, economic development and mobility, spawning prosperous cities and cultures at their intersections. Whatever it means to be European today owes much to the design of the *viae publicae*, the public highways of Ancient Rome.

The vignette above, illustrating a case of literal path dependency, or how past decisions delimit future possibilities, is only one, albeit powerful, case for why design isn't *just* design, be it urban, industrial, or infrastructural. Design adjusts the parameters for what we are, for what is probable, and for what we can become. Design is the bootstrap by which animals, humans in particular, become capable of lifting themselves up to novel levels of existence. It is how culture ratchets its growth, how social systems encode what they learn, and how people navigate through a near-chaotic world riddled with uncertainties. Design deserves a much more comprehensive treatment than what I can offer in one essay, but what I can do is provide a modest summary of the ecology of design, beginning with evolutionary ecology and then delving deeper into what is known as ecological psychology.

A less appreciated triumph of Charles Darwin's, the father of the theory of evolution by natural selection, are his **experimental studies on earthworms**, whose habits Darwin claimed to have studied for forty years. "Earthworms," **Odling-Smee et al.** noted of Darwin's work, "through their burrowing activities, . . . change both the structure and chemistry of soils,"² resulting in altered sets of selection pressures for future generations. Much like how the Romans modulated the niche of their descendants to favour certain kinds of commercial activities, earthworms too alter the environments passed on to their offspring, modulating their **ecological inheritance**. Darwin did not conceive a name for this autocatalytic effect, which peculiarly escaped mainstream scientific attention until the late 20th century. Today, however, it is commonly known in evolutionary ecology as **niche construction**,³ referring explicitly to the modification of selective environments by organisms. In the loopy world of niche construction, organisms influence their own evolution, not only by being objects of natural selection but also by being active designers of the conditions for natural selection. Design, in other words, is self-induced selection pressure.

Since the late 1980s, niche construction has been studied in a variety of species, such as wasps and ants, and, perhaps unsurprisingly, has also found a strong foothold in the human sciences, including archaeology, biological anthropology, and psychology. This is not only because niche construction seems to have played a central role in the development and evolution of human cognition, but also due to human beings' unrivalled potential for constructing and controlling environments, as the case of Roman highways illustrates. But perhaps what sets us even further apart from the rest of the animal world is our destructive capacity. In fact, most of our most pressing and current socio-ecological problems, such as climate change, biodiversity loss, deforestation, and chemical pollution, are upon closer inspection by-products of niche construction. More specifically, since the selection pressures in niche construction refer explicitly to genetic selection, the ongoing and impending ecological catastrophes are products of cultural niche construction.

Cultural niche construction occurs when organisms modify environmental states in non-random ways, thus imposing systematic biases on the behavioural selection pressures the environments generate. These biases, I argue, are transmitted through the conscious and unconscious design of affordances. An affordance, a concept conceived by ecological psychologist James J. Gibson, is often **defined** as a functional relation between abilities of an organism and features of an environment.⁴ For example, one instinctive affordance of a chair for a bipedal organism such as ours is "sitting." Or, as **Darwin noted** in his very same inquiries on earthworm behaviour, the tip of a leaf affords "pulling" for a worm.⁵ Whatever affordances we perceive owe to ecological information, or the sets of structures and regularities in the environment, **from patterns in light to social norms and conventions**, that allow an animal to engage with affordances.⁶

According to ecological psychologists, we do not perceive the world as passive or

meaningless, but rather as one which invites, constrains, or *affords* behaviours. And our everyday environments, or designer niches, as cognitive scientist Donald Norman *has famously noted*,⁷ are for better or worse filled with affordances, some more intuitive and soliciting than others. Take Roman highways as an example, which were originally constructed mainly for military expansion, and which as a consequence non-randomly altered the environment to favour transport on wheels. This significantly increased the affordances pertaining to trading activities, thus creating cultural selection pressure for trade-related behaviours and attitudes, increasing demand for enhanced trading affordances. What resulted was a self-reinforcing cycle, which today manifests as the near-impossibility for an individual or a society to opt out, either behaviorally, culturally or attitudinally, from Pan-European trade. Whatever cultural practices exist today are built on loops of niche construction, ecological inheritance, ecological information, and perceivable and actionable affordances. Thus, culture emerges from the ecology of design.

Philosopher of science and ecological psychologist Edward Reed, in his magnificent book *Encountering the World*, argues that the whole notion of culture arises from this kind of bootstrapping process, where the agglomeration and proliferation of specific affordances forms a “field of promoted action,” which spurs new practices, ideas, inventions, values, and socio-cultural interactions.⁸ Design breeds affordances, affordances breed behaviours, behaviours breed ideas, and ideas breed, you guessed it, design. This accumulation is also known as the *ratchet-effect*, or the notion that human socio-technological culture accumulates irreversible modifications over time.⁹ These loopy modifications are embodied and embedded at *various levels of existence*, from neural networks, habits, values, cultural artefacts, and constructed environments, ratcheting our way to emergent novelty.¹⁰

As I have argued elsewhere in greater detail,¹¹ whatever fields of promoted action exist in urban ecological niches today, the world we encounter in them is primarily unsustainable, non-aesthetic, and generally does not intuitively afford the behaviour we would wish for. If organisms tend to adapt to *become models of the world they inhabit*,¹² a world they take part in creating, it is little wonder that we have been, both in common lingo and in practice, reduced to mere “consumers.” Importantly, however, this fate is not inevitable, and much of it is a direct result of inattentive design

Whatever niche we are constructing today is a question of politics, of design choices. So why are we not paying more attention to how we construct our niche? Perhaps it is due to our incapacity of perceiving the loopy, self-reinforcing feedback our designed environments impose on us. After all, the Romans likely hadn’t an inkling of the import of their highways for future generations. Perhaps it owes to the far-reaching and not immediately perceivable consequences of design. Or perhaps it is due to the incrementality of design choices, which step-by-step alter the environments which modulate ourselves. Whatever the reason, this lack of attention and intent must end

before it is too late.

James J. Gibson, the originator of the ecological approach to psychology, is not generally known as a sustainability scholar, but his message in *The Ecological Approach to Ecological Perception* is powerful: “There is only one world, however diverse, and all animals live in it, although we human animals have altered it to suit ourselves. We have done so wastefully, thoughtlessly, and, if we do not mend our ways, fatally.”¹³

We must focus more thought, more attention, and more *intention* into niche construction, and ask ourselves: What are the *viae publicae*, the public highways, towards a sustainable society? How do we make our designer environments **afford sustainable action**? We must learn to become better stewards of niche construction, parting from our wasteful and thoughtless habits and moving rapidly towards intentional **ecodesign**. For we are not only designers of environments, we are designers of environments which modulate all life and spirit on Earth, including our own. Design might not seem like much, but its effects just might ripple through millennia.

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Notes

¹ Carl-Johan Dalgaard et al., “Roman Roads to Prosperity: Persistence and Non-Persistence of Public Goods Provision,” *CEPR Discussion Papers* 12745.

² F. John Odling-Smee, Kevin N. Laland, and Marcus W. Feldman, “Niche Construction,” *The American Naturalist* 147, no. 4 (April 1996): 642.

³ Kevin Laland, Blake Matthews, and Marcus W. Feldman, “An Introduction to Niche Construction Theory,” *Evolutionary Ecology* 30, no. 2 (April 2016): 191–202.

⁴ Anthony Chemero, “An Outline of a Theory of Affordances,” *Ecological Psychology* 15, no. 2, 181–195.

⁵ Edward S. Reed, “Darwin’s Earthworms: A Case Study in Evolutionary Psychology,” *Behaviorism* 10, no. 2 (Fall 1982), 165–185.

⁶ Jelle Bruineberg, Anthony Chemero, and Erik Rietveld, “General Ecological Information Supports Engagement with Affordances for ‘Higher’ Cognition,” *Synthese* (February 2018), doi: <https://doi.org/10.1007/s11229-018-1716-9>

⁷ Donald Norman, *The Design of Everyday Things* (New York: Basic Books, 2002).

⁸ Edward Reed, *Encountering the World* (Oxford: Oxford University Press, 1996).

⁹ Claudio Tennie, Josep Call, and Michael Tomasello, “Ratcheting up the Ratchet: On the Evolution of Cumulative Culture,” *Philosophical Transactions of the Royal Society B: Biological Science* 364, no. 1528 (August 2009). doi: <https://doi.org/10.1098/rstb.2009.0052>

¹⁰ Maxwell J. D. Ramstead, Samuel P. L., Vessière, and Laurence J. Kirmayer, “Cultural Affordances: Scaffolding Local Worlds Through Shared Intentionality and Regimes of Attention,” *Frontiers in Psychology* 7, no. 1090. doi:10.3389/fpsyg.2016.01090

¹¹ Roope Kaaronen, “Affording Sustainability: Adopting a Theory of Affordances as a Guiding Heuristic for Environmental Policy,” *Frontiers in Psychology* 8 no. 1974. doi:10.3389/fpsyg.2017.01974

¹² Karl Friston, “The Mathematics of Mind-Time,” *Aeon*, May 18, 2017.

¹³ James Gibson, *The Ecological Approach to Visual Perception* (New York: Psychology Press, 2015), 122.